

## G05DJF – NAG Fortran Library Routine Document

**Note.** Before using this routine, please read the Users' Note for your implementation to check the interpretation of bold italicised terms and other implementation-dependent details.

### 1 Purpose

G05DJF returns a pseudo-random real number taken from a Student's  $t$ -distribution with  $n$  degrees of freedom.

### 2 Specification

```
real FUNCTION G05DJF(N, IFAIL)
  INTEGER          N, IFAIL
```

### 3 Description

The distribution has PDF (probability density function)

$$f(x) = \frac{\left(\frac{n-1}{2}\right)!}{\left(\frac{1}{2}n - 1\right)! \sqrt{\pi n} \left(1 + \frac{x^2}{n}\right)^{\frac{1}{2}(n+1)}}.$$

The routine returns the value

$$y \sqrt{\frac{n}{z}}$$

where  $y$  is generated by G05DDF from a Normal distribution with mean 0 and standard deviation 1.0, and  $z$  is generated by G05DGF from a gamma distribution with parameters  $\frac{1}{2}n$  and 2 (i.e., from a  $\chi^2$  distribution with  $n$  degrees of freedom).

### 4 References

- [1] Knuth D E (1981) *The Art of Computer Programming (Volume 2)* Addison–Wesley (2nd Edition)

### 5 Parameters

- 1: N — INTEGER *Input*  
*On entry:* the number of degrees of freedom,  $n$ , of the distribution.  
*Constraint:*  $N \geq 1$ .
- 2: IFAIL — INTEGER *Input/Output*  
*On entry:* IFAIL must be set to 0,  $-1$  or 1. For users not familiar with this parameter (described in Chapter P01) the recommended value is 0.  
*On exit:* IFAIL = 0 unless the routine detects an error (see Section 6).

### 6 Error Indicators and Warnings

Errors detected by the routine:

IFAIL = 1

On entry,  $N < 1$ .

### 7 Accuracy

Not applicable.

## 8 Further Comments

The time taken by the routine increases with  $n$ .

## 9 Example

The example program prints the first five pseudo-random real numbers from a Student's  $t$ -distribution with 5 degrees of freedom, generated by G05DJF after initialisation by G05CBF.

### 9.1 Program Text

**Note.** The listing of the example program presented below uses bold italicised terms to denote precision-dependent details. Please read the Users' Note for your implementation to check the interpretation of these terms. As explained in the Essential Introduction to this manual, the results produced may not be identical for all implementations.

```
*      G05DJF Example Program Text
*      Mark 14 Revised.  NAG Copyright 1989.
*      .. Parameters ..
      INTEGER          NOUT
      PARAMETER        (NOUT=6)
*      .. Local Scalars ..
      real             X
      INTEGER          I, IFAIL
*      .. External Functions ..
      real             G05DJF
      EXTERNAL          G05DJF
*      .. External Subroutines ..
      EXTERNAL          G05CBF
*      .. Executable Statements ..
      WRITE (NOUT,*) 'G05DJF Example Program Results'
      WRITE (NOUT,*)
      CALL G05CBF(0)
      IFAIL = 0
      DO 20 I = 1, 5
*
*          X = G05DJF(5,IFAIL)
*
*          WRITE (NOUT,99999) X
      20 CONTINUE
      STOP
*
99999 FORMAT (1X,F10.4)
      END
```

### 9.2 Program Data

None.

### 9.3 Program Results

G05DJF Example Program Results

```
0.9435
1.3828
-0.4164
1.0801
1.1445
```